



Innovative Approaches for Recycling Munitions Workshop



Mr. Jim Lawrence, ELG Metals:

- Moderator
- Opening Remarks

Mr. Barry Schaffer, Demil Metals, Inc:

- Speaker Introduction

Innovative Approaches for Recycling Munitions



LTC Brian Raftery
PM Demilitarization
973-724-5276
brian.raftery@us.army.mil

19 April 2007

Good Morning – and thanks for attending our workshop and allowing us to share one of our greatest challenges; how to reduce the large and growing stockpile of munitions that have been designated for demilitarization.



Purpose



- **Develop increased customer base for recyclable materials from the demilitarization of munitions**
- **Workshop Content:**
 - ✓ **Provide information regarding DoD's management for demilitarization of munitions**
 - ✓ **Describe demil processes**
 - ✓ **Describe demil requirements**
 - ✓ **Characterize the demil stockpile**
 - ✓ **Describe opportunities for recycling materials from the stockpile**
 - ✓ **Provide a discussion forum to answer questions**

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Our purpose for this workshop is to provide information about munitions demilitarization and to create an open forum to gain your insight into what we may do to better support the scrap industry and answer your questions.



Single Manager for Conventional Ammunition

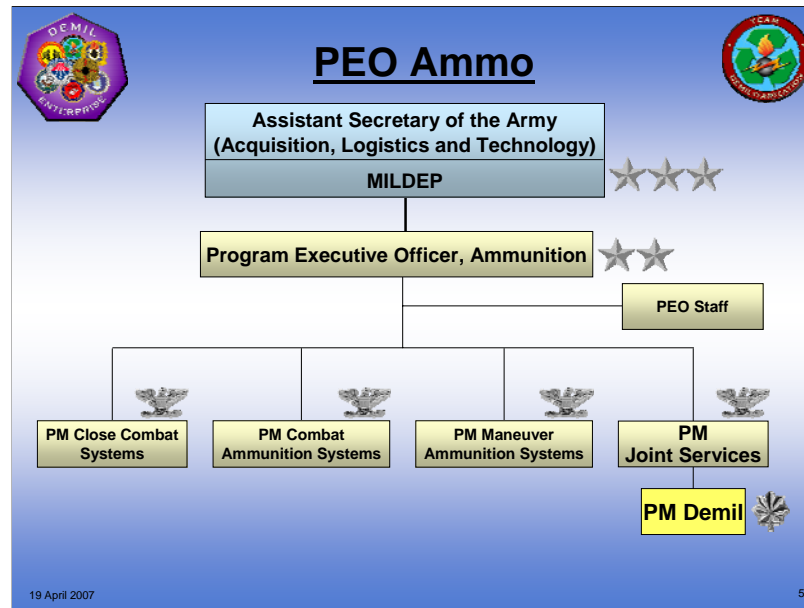


- The Single Manager for Conventional Ammunition (SMCA) is a centralized entity that integrates multiple organizations to satisfy the Department of Defense's conventional ammunition requirements
- The mission, performed by the Army, is to achieve economies in procurement, storage, **demilitarization, disposal** and transportation of conventional ammunition for the United States military services and other customers

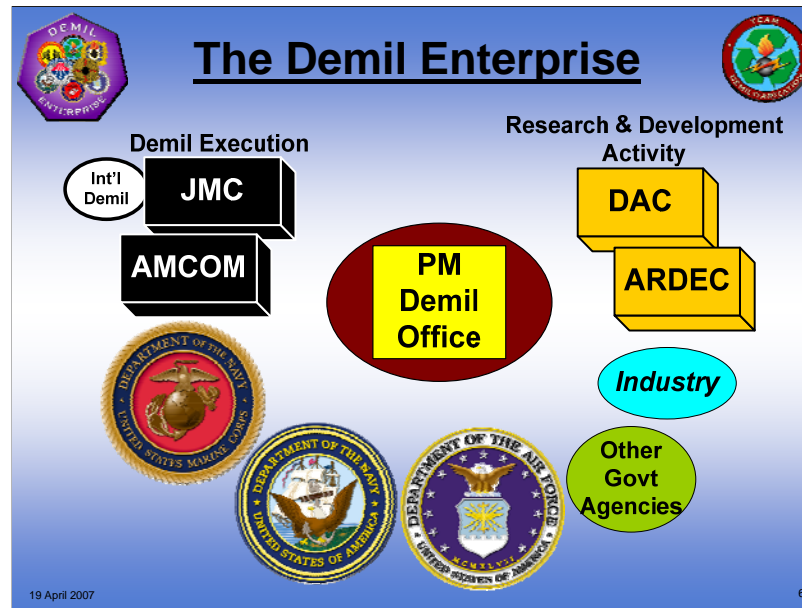
Secretary of the Army – DoD SMCA
PEO Ammunition – SMCA Executor
**PM Demil – Single Point of Contact for
Conventional Ammo Demil/Disposal**

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The Department of Defense has designated the Secretary of the Army as the Single Manager of Conventional ammunition (SMCA). As the SMCA, The Army is responsible for funding and executing DOD's conventional ammunition requirements and specifically for this forum, the demilitarization of conventional ammunition for all the Military Services. Execution responsibility is delegated to the Program Executive Officer, Ammunition, MG Paul Izzo, located at Picatinny Arsenal, NJ. For the purpose of demil, Conventional Ammunition includes tactical missiles.



This org chart shows the PEO Ammunition, the organizations that develop and procure new munitions products, and the Joint Services organization that my office is part of. The Joint Services group manages activity that supports all the Military Services.



The Product Manager Demil Office has a strategic-level management responsibility for munitions demilitarization – planning, budgeting, funding, and execution. Execution is accomplished through an extended matrix of resources that includes a diverse group of people, locations, and infrastructure. This collection of organizations is known as the “Demil Enterprise”.


JMC is the Joint Munitions Command located at Rock Island Arsenal, IL.

AMCOM is the Aviation and Missile Command at Redstone Arsenal, Huntsville, AL


DAC is the Defense Ammunition Center at McAlester, OK.

ARDEC is the Armament Research, Development and Engineering Center at Picatinny Arsenal, NJ.

Each of the military Services is also represented in the Demil Enterprise organization.



Demil Enterprise Mission, Vision and Goals



<p><u>Mission:</u> The Demil Enterprise performs end of life cycle management for conventional ammunition to include disposition, demilitarization, and disposal with an emphasis on closed disposal including <u>economically viable resource recovery and recycling for all DoD services</u>. Further the Enterprise performs demil R&D and influences ammunition design for demil to reduce ammunition total life cycle costs.</p>	<p><u>Goals:</u></p> <ol style="list-style-type: none"> 1. Reduce the demil stockpile 2. Emphasize closed disposal 3. <u>Implement resource recovery and recycling</u> when economically viable 4. Promote Design for Demil as policy and requirement for all new or modified conventional ammunition products 5. Match demil execution infrastructure capability and capacity to execution requirements 6. Use strategic planning to guide operational action 7. Pursue, transition, and integrate R&D technologies that close capability gaps and increase cost effectiveness 8. Safety and environmental stewardship 9. Enhance collaboration and communication within the Demil Enterprise 10. Strive for continuous improvement in all Demil Enterprise activities
<p><u>Vision:</u> <i>A seamless, effective joint enterprise of acquisition and functional expertise committed to efficient reduction of the U.S. conventional munitions demil stockpile that improves Warfighter readiness, and enhances safe operations while safeguarding the natural environment for the American People.</i></p>	

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The Demil Enterprise has established a formal mission statement and 10 specific performance goals. Note the prominence of resource recovery and recycling in our mission as well as our goals. Goal #1 is most important: Reduce the demil stockpile. So far we are not doing well in that area.



Munitions Products Requiring Demilitarization

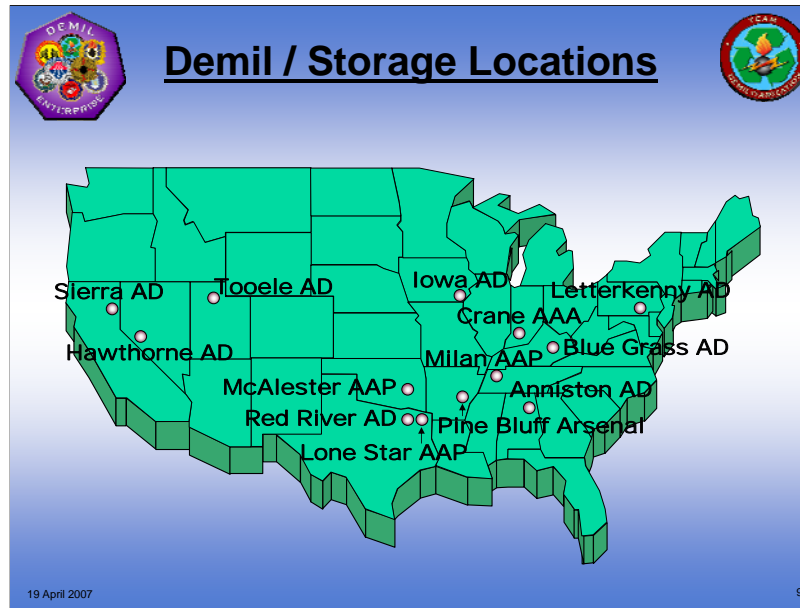
Products are transferred to the demil stockpile when declared excess, obsolete or defective by the Military Services' Item Managers

- Small arms, mortar, automatic cannon artillery, and ship gun ammunition
- Bombs (cluster, fuel air explosive, general purpose, and incendiary)
- Unguided rockets, projectiles, and sub-munitions
- Land mines (ground-to-ground and air-to-ground delivered)
- Demolition materiel
- Grenades
- Flares and pyrotechnics
- Components of the items above (e.g. explosives; propellants; cartridges; propelling charges; projectiles; warheads with various fillers; fuzes; boosters; and safe and arm devices)
- Related ammunition containers and packing and packaging materials

Source: SMCA assigned items from DODD 5160-65 (14 April 2004)

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Each of the services initiates a formal transfer of ownership when products are put in the demil stockpile. You could say that we manage DOD's conventional ammunition scrap yard. These are the major types of products that comprise the demil stockpile. You can imagine the types of scrap that demilitarization of these products would generate. I will provide more technical information later in the briefing.



This map shows the domestic storage locations for the demil stockpile. As you can see, they are spread across the United States.



Current Munitions Demil Processes by Location



Current Demil Processes	LOCATIONS								
	Anniston	Blue Grass	Crane	Hawthorne	Iowa	Letterkenny	McAlester	Red River	Tooele
OB / OD	x	x	x	x		x	x	x	x
Incineration				x			x		x
Autoclave			x	x			x		
High Pressure Water Washout				x					
Steam-out				x					
Hot Water Washout		x							
White Phosphorus			x						
Explosive D			x						
Depleted Uranium Recovery from Large Cal					x				

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Many of the storage locations are also operational sites where demil “execution” is performed. This chart shows some of the primary processes, by site, that are used to achieve demilitarization and generate our scrap. In the past there has been a heavy dependency on “open burn/open detonation” as a process for demilitarization. Although quite effective and cost efficient, environmental compliance issues are forcing a change to “closed disposal” processes that are significantly more expensive.

Current Demil Processes

Hot Gas Decontamination Furnace

Low Temp Distortion-Free Process

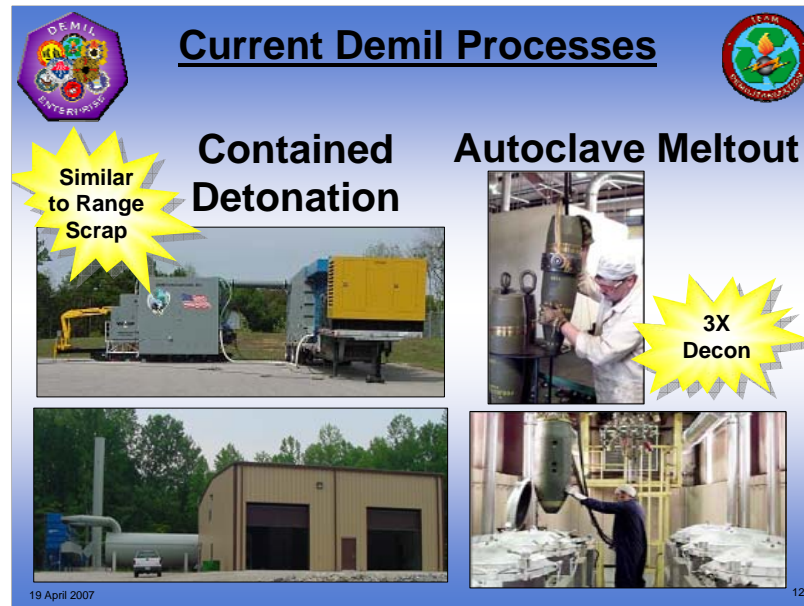
Deactivation Furnace

Generates 5X Scrap

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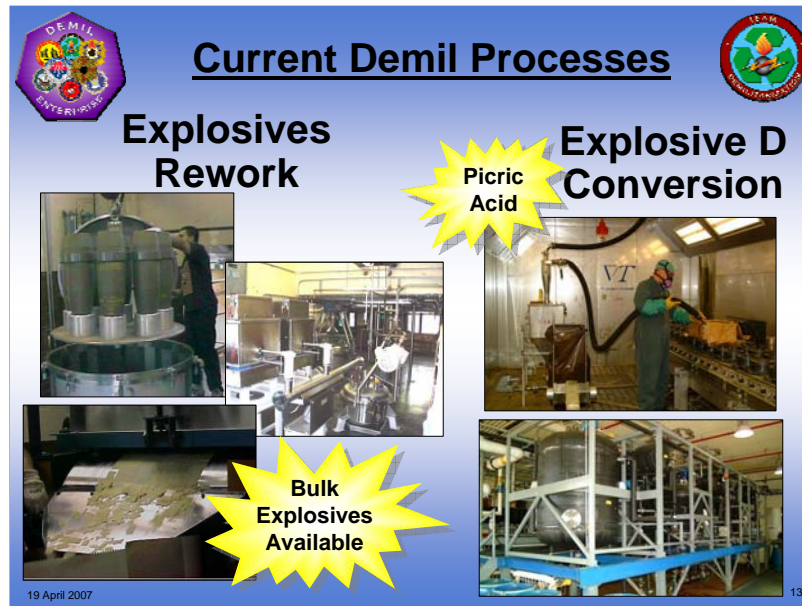
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The Hot Gas Decontamination Furnace is used for both range and demil scrap processing at Hawthorne. Along with the Deactivation Furnace, these processes are used to remove traces of explosive from the scrap. Deactivation Furnaces are located at Crane AAA, McAlester AAP, Tooele AD, Japan.




Another demil process for small explosive components is “contained detonation” technology. This is a niche technology for small items that are generated from disassembly and is not intended for large production throughput. A transportable unit is located at Anniston Defense Munitions Center. Stationary units are located at Crane Army Ammo Activity (CAAA) and Blue Grass Army Depot (BGAD).

The autoclave process is well established and typically used to melt out the explosive material from artillery shells and bombs for either reuse or donor material. This process capability is located at Hawthorne AD, McAlester AAP, Egypt, Korea.







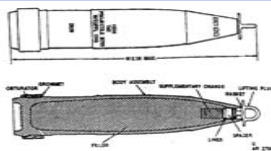

At MCAAP, we have developed a capability to rework the recovered TNT to bring it back up to spec grade and reused. Melted-out TNT is re-flaked to be recycled into new munitions.

Another removal and conversion process being developed is the washout of Explosive D (Ammonium Picrate) from projectiles and converting it to Picric Acid for commercial sale. Explosive D is difficult to process and this provides an effective alternative to open detonation. Location- Crane AAA.



Current Demil Processes as a Source of Supply



<p><u>TOW Missile Components:</u></p> <ul style="list-style-type: none"> • Missile Case (FMS & US Production - 15K) • Operation Iraqi Freedom (Retrograde Use) <ul style="list-style-type: none"> • Foam Cushion • End Caps • Potential Reuse: <ul style="list-style-type: none"> • Launch Motor Nozzle • Coated Launch Motor Case 	<p><u>TNT:</u></p> <ul style="list-style-type: none"> • 17M lb Dept of Defense requirement thru FY05 • As of March 05, 13.4M lbs used/available 
<p><u>Supplementary Charges:</u></p> <ul style="list-style-type: none"> • 8" & 105mm ammo reused in new 155mm (M795 & M107) & 105mm (M927) projectiles <div style="display: flex; align-items: center;">   </div> <p style="font-size: small;">19 April 2007</p>	<p><u>Depleted Uranium Penetrators:</u></p> <ul style="list-style-type: none"> • Reused in new M829A3 120mm tank & M919 25mm cartridges • Approximately 137K in Demil account <p style="text-align: center; font-size: small;">M829 120mm Armor Piercing, Fin Stabilized, Discarding Sabot-Tracer (APFSDS-T) cartridge with DU penetrator</p> 

Some of the products and materials that result from the current demilitarization processes are suitable for reuse. We call this a “source of supply” as it provides components for the production of new munitions.



Current Demil Processes as a Source of Scrap



Scrap Material Generated in a Typical Year by the Government's Munitions Demil Operations

Material (in pounds)	Annisson	Blue Grass (1)	Crane	Hawthorne (2)	McAlester (3)(4)	Red River	Tooele	Total
Aluminum	115,000							115,000
Aluminum Alloy	3,750	26,495	324,240	435,416	47,104	286,373	118,096	1,241,474
Brass		2,457		286,488	5,240			294,185
Copper	22,000		103,293					125,293
Copper Alloy		349,871		398,095	79,820			827,786
Propellants		264,605		372,872	572,500	56,550	132,858	1,399,576
Explosives		978,797	134,791	2,055,228	490,000			3,658,816
Lead Alloy		1,059		85,099	2,890			89,048
Phosphorus bronze				9,305				9,305
Stainless steel			68,252	67,172		19,048		154,472
Steel	130,000	1,587,238	1,598,040	5,795,450	3,021,000	248,422	404,489	12,784,639
Wood / Fiberglass	440,000							440,000
Zinc Alloy		1,266		25,000				26,266

Note:

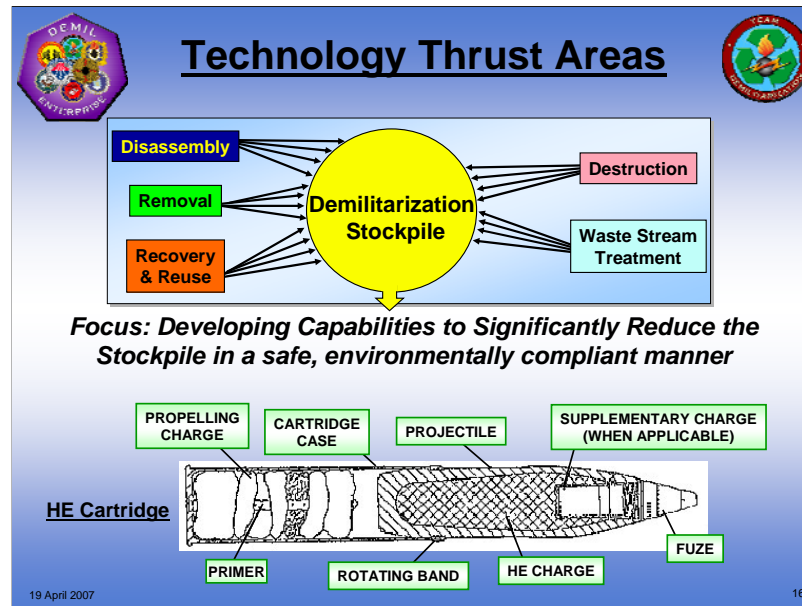
Propellants burn
Explosives detonate

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(1) Recovered Comp B available for commercial sale
(2) D&Z Inc takes title to all recovered matl; avail for resale through D&Z
(3) MCAAP takes title to Bomb bodies (750 bomb meltout)
(4) Tritonal from bomb autoclave process is GD-OTS property


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Materials that are not reusable within the government are considered scrap and are available for sale or disposal. This chart shows some of the more common materials that result from current processes for demilitarization. The quantities shown are for a typical year at our current level of activity and processing. These quantities are “organic” generations and do not include scrap generated by commercial demil operations that are contracted by the government to perform munitions demil.




Because there is such a wide variety of ammunition assembled using a variety of methodologies with a variety of explosive fills, the enterprise must explore numerous technologies to address complete demilitarization of a munitions item. In order to get our arms around this challenge, development efforts have been broken up into thrust areas. Unfortunately, there is no silver bullet for the demil of all munitions items, and in most cases, there isn't even a single silver bullet for the demil of one munition item. It takes one or more of the thrust areas to provide complete demilitarization.

To gain a better appreciation of why there is no silver bullet for all munitions, A relatively simple, typical projectile has several components involved. Over a decade ago, we would have mostly addressed demilitarization with open burning and open detonation. Our focus now is to look for closed disposal methods (any method other than OB/OD) to not only comply with more stringent environmental guidance, but to also recovery and/or reuse any component with a justifiable value.



Emerging Demil Processes

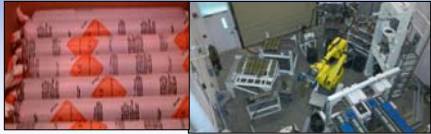




Disassembly/Removal

- Abrasive Waterjet Cutting
- Robotic Disassembly (CBU)
- Robotics Disassembly (ADAM)
- Ultrasonic Fragmentation

Resource Recovery & Recycling

- ArcTech Propellant Conversion to Fertilizer
- Blasting Agent Manufacturing
- Demilitarization by Induction Heating Meltout (DIHME)
- Energetics Recovery & Requalification
- Flashless Powder
- Gun Propellant Constituent Recovery
- HMX Recovery
- Magnesium Recovery/Reuse
- Missile Recycling Center
- Near IR Propellant Stability Analyzer
- Thin-Layer Chromatography

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The emphasis on “closed disposal” has caused the government to make major investments in new technology for demilitarizing munitions. The next two charts highlight some of these emerging technologies and their area of application; “Disassembly Processes”, “Resource Recovery and Recycling”, and (next chart)



Emerging Demil Processes



Destruction

- Acid Digestion for Demil of IM
- Bulk Energetic Demilitarization System (BEDS)
- CAD/PAD Hydrolysis
- Contained Detonation Chamber
- Cryofracture Technology
- Cryofracture CBUs
- Mobile Cryo-Plasma Demilitarization System
- Photocatalytic Degradation of Energetic Materials
- Plasma Arc Thermal Treatment (Mobile and Stationary)

Waste Stream Treatment

- Molten Salt Oxidation
- Supercritical Water Oxidation





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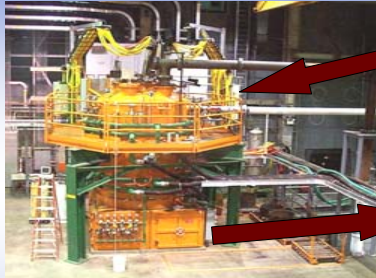
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“Destruction”. Additionally, several technologies are aimed at “Waste Stream Treatment”.

The reason for showing these emerging technologies to you is to possibly stimulate your thinking about how these processes may relate to operations in your industry and the disposition of the “scrap” materials that result.



Plasma Ordnance Demil System (PODS)



Technology: Thermal treatment using a super hot (25,000°F) plasma, created by electrical energy input into a gas flowing through a torch. Organic materials are destroyed. Inorganics are melted into a non-hazardous slag or recoverable metal layer.

Stockpile Focus: Small, fully assembled pyrotechnic and smoke munitions; fuzes; CADs/PADs; no other technology exists for most pyro items

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We are aware of plasma incineration activity within the commercial sector and expect you may have knowledge of this process and how to dispose of the resulting waste.



Mobile Plasma Treatment System (MPTS)





Technology: Thermal treatment using a super hot (25,000°F) plasma, created by electrical energy input into a gas flowing through torch. Organic materials are destroyed. Inorganics are melted into a non-hazardous slag or recoverable metal layer.

Stockpile Focus: Small, fully assembled pyro and smoke munitions; CADs; PADs; Fuzes


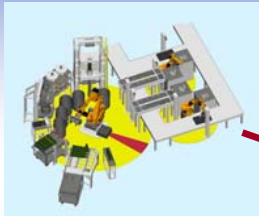
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This is a version of the plasma incinerator that can be relocated among the sites where munitions are stored, avoiding the hazards and expense of transportation.



Cryofracture Demil



Technology: Munitions are made brittle by freezing in liquid N₂ (-323°F) and then fractured using a hydraulic press. Fractured pieces can then be treated via thermal deactivation or separation/recovery

Stockpile Focus: Small, steel-bodied, HE-loaded munitions such as grenades, mines, and submunitions found in ICMs, CEMs and CBUs

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Similarly, we are aware that cryofracture is used in your industry. After a thermal deactivation process, the resulting material is demilitarized scrap.



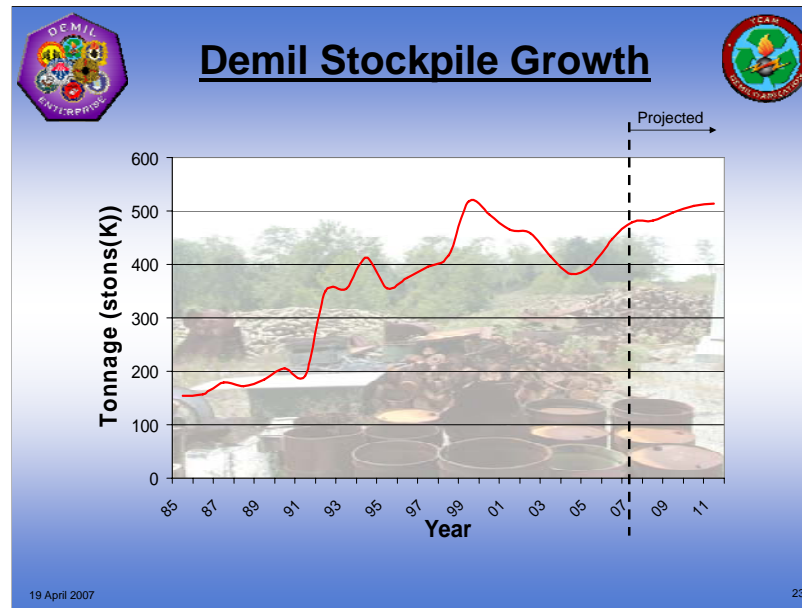
Emerging Demil Processes by Location



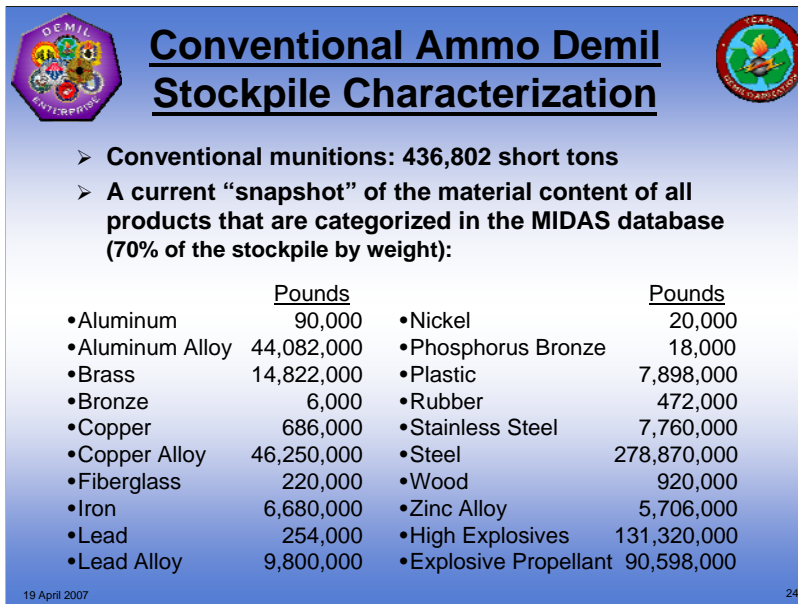
Emerging Demil Processes	LOCATIONS								
	Aniston	Blue Grass	Crane	Hawthorne	Iowa	Letterkenny	McAlester	Red River	Tooele
Contained Burn of Rocket/Missile Motors				X					
Missile Recycling Center	X								
Plasma Ordnance Destruction System				X					
Base Hydrolysis									X
Cryofracture with Incineration							X		
Propellant to Blasting Slurry Conversion	X			X					
Propellant to Fertilizer Conversion			X			X			
Detonation Chamber	X	X	X						
Molten Salt Oxidation		X							
CBU Cryofracture				X					
Mobile Plasma Treatment System			X						
MG Recovery			X						

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This chart shows some of the “emerging” demil processes and the locations where they may be located.



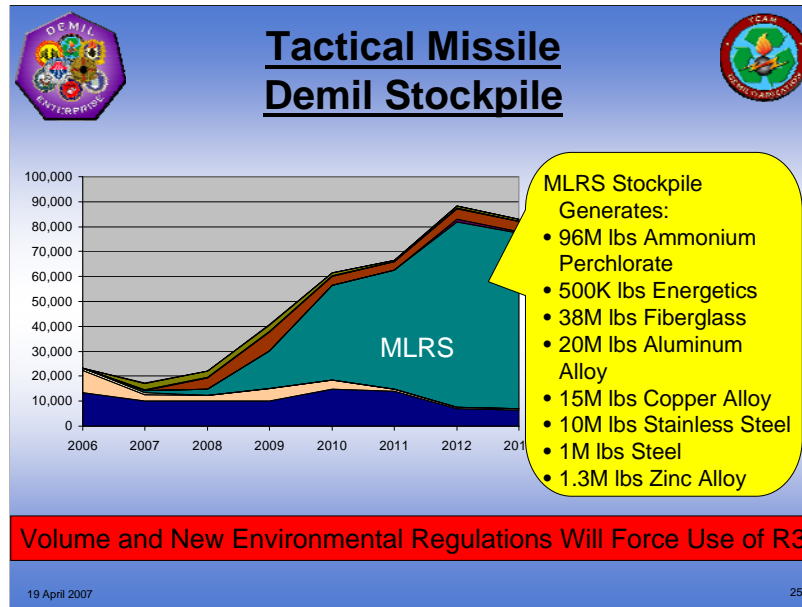
Remember the #1 goal for the demil enterprise - “reduce the demil stockpile”. This chart shows the historical trend of the size of the conventional ammunition stockpile. We are approaching 500,000 short tons.



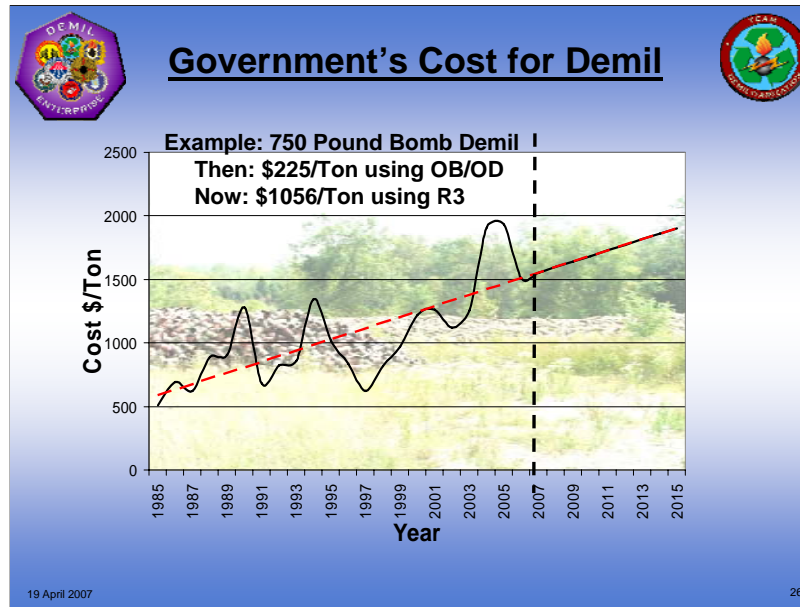
These numbers don’t include packing material – for example: ammo cans, pallets, prop charge cans

We use a database called MIDAS, “Munitions Items Disposition Action System”, to maintain and communicate the characteristics of the products in the demil stockpile. Any process used for destruction must consider what happens to all the constituent materials during processing and their eventual disposal. Along with that purpose, the database is capable of sorting in a manner that tells us the material makeup of the stockpile as a whole.



This slide is a “snapshot” of the current demil stockpile for conventional ammo. MIDAS data comprises roughly 70% by weight of the conventional ammo demil stockpile



It is apparent that we are in for a surge due to MLRS rockets reaching their design shelf-life that will require timely disposal to avoid safety issues. We've tried to represent the impact of this major demilitarization for MLRS rockets by showing the expected total recyclable materials from that effort.



Legacy demil relied on open burn / open detonation. Closed disposal requirements and inflationary pressures have caused an upward trend for the cost of demil. In the future, due to policy and regulations, demil will be going to higher level of R3 and thus will be more expensive on a per-unit basis.



New Demilitarization Law **Effective FY2007** **Resource Recovery and Recycling (R3)**

BEFORE

1. Installations execute demilitarization.
2. Salvageable material sold.
3. Proceeds sent to US Treasury.

AFTER

1. Installations execute demilitarization.
2. Salvageable material sold.
3. Proceeds reinvested into R3 Programs.

THE LAW

The Law allows the Army to sell recyclable munitions materials resulting from demil and to reinvest the proceeds into demil Resource Recovery and Recycling


THE BENEFIT

Return of revenue from recycling to support Demil R3 programs

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Before FY07, proceeds from the sales of recycled material by DRMOs were returned to the US Treasury. Beginning in FY07, proceeds will be deposited into an Army Demilitarization Account to be used to support R3 Programs. PM-Demil will manage the financial records and approve all distributions from the account.

Operational installations will now have an incentive to develop cost effective processes for the disposal of scrap. This is a major change in the business model that is intended to help address the funding shortfall for munitions demil. We are looking for ideas on how to maximize return on our scrap.



Demil Request for Information from Industry



- **Advertised RFI in Sep 06 (closed Nov 06)**
- **Purpose-reduce the Demil stockpile**
 - ✓ Increase demil per dollar spent
 - ✓ New opportunities for industry
 - ✓ Innovative alternatives based on sound business practices
 - ✓ Win – Win Solutions for Government and Industry
- **Received 11 Responses From Demil Stakeholders that will help shape future Government competitive acquisition strategies for disposal of materials**

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Although the return of revenue from scrap sales will help our problem, it is not a complete solution.

In the fall of 2006, we advertised a call for Industry input of innovative approaches for reduction of the demil stockpile. Responses came from many of the stakeholders in the current ammunition industry, but none from external industry, such as yourselves.



Opportunities for Industry



- **Direct sales of usable items (i.e. obsolete small caliber ammunition)**
- **Development of new customers for recyclable materials**
- **Suggest new approaches for the Government's contracting strategy**
- **Suggest new models for the business process**
 - ✓ **"In-Kind" exchanges**
 - ✓ **Partnerships**
 - ✓ **Co-Location**

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We believe the demil stockpile has inherent value, and with the application of new and innovative approaches, we could increase the rate at which we dispose of these products. Our goal is to reduce the stockpile by 6% annually. We would welcome your input of ideas to complement those received from the ammunition community.

This chart shows some of the areas that we feel additional input would be of value.



Requirements for Demilitarization (Law and DoD Policy)



- Documented “CHAIN OF CUSTODY” that can track and account for all material
- All material to be handled within EPA & OSHA rules and regulations
- Ability to conduct on site inspections of the recycling processes to ensure compliance with the demilitarization plan
- “END USE CERTIFICATE” certifying the recycling and destruction of the material to prevent future use as ordnance

Note: applies to items needing demil not scrap items

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Some of you may already have experience dealing with the demilitarization process and will recognize these requirements. In most cases, these requirements apply to the government’s internal operations for demilitarizing munitions. In some cases this work is performed by contractors.



Government's Obligation Regarding Demil Scrap



- **Provide raw material feedstock rendered to a minimum of 3X condition**
- **Deliver homogeneous raw material feedstock that complies with the chemistry/size/shape requirements**
- **Offer ability to inspect and understand the demilitarization operation that rendered the ordnance to a minimum 3X condition**
- **Execute an uninterrupted program, once it commences, in order to maintain reliability of supply**

Note:

- 3X decon leaves a visible explosive film with no chunks
- 5X is explosive free

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We recognize that to gain confidence and interest in our product, government must consider your business requirements. "3X condition" means that the item has been completely demilitarized but scrap material could still contain traces of explosive residue and requires scrap recyclers to be certified to handle 3X.



**This Briefing is posted on the
PM Demilitarization Website**



<http://www.pica.army.mil/PMDemil>

**2007 Global Demilitarization Symposium
and Exhibition**

www.ndia.org/meetings/7580

May 14-17, 2007

Grand Sierra Resort & Casino, Reno, NV

Previous RFI info is posted at:

<http://www.afsc.army.mil/ac/aais/ioc/demilitarization/index.htm>

- ✓ Army Sustainment Command Website
- ✓ AAIS Acquisition Center Link
- ✓ Demilitarization of Conventional Ammo Stockpile Link

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If you desire future reference to this briefing, it is posted at this web site.



Points of Contact for Future Questions/Comments/Ideas



- **Mr. Orest Hrycak**
973-724-6937 orest.hrycak@us.army.mil
- **Mr. Tom Carr**
256-379-4304 tcarr@camber.com
- **Mr. John Semler**
231-944-3132 jsemler@camber.com

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Hopefully we have stimulated your thinking which may result in future questions. Please feel free to contact any of these folks, who, acting as my representative, will see that you get a response that suits your need and our ability to provide the information. Orest is on our panel and Tom and John are in attendance.

Acronyms/Definitions			
ADAM	Area Denial Artillery Munition	IR	Infrared
ADMC	Armistice Defense Munitions Center	ISRI	Institute of Scrap Recycling Industries
AEC	Army Environmental Command	JMC	Joint Munitions Command
AMC	Army Materiel Command	LEMC	Letterkenny Munitions Center
AMCOM	Aviation and Missile Command	MaT	Material and Training Stocks
AMRDEC	Aviation and Missile Research and Development and Engineering Command	MCAAP	McAlester Army Ammo Plant
ADMC	Armistice Munitions Center	MG	Magnesium
APFSDS-T	Armor Piercing, Fin Stabilized, Discarding Sabot-Tracer	MLRS	Multi-Launch Rocket System
ARDEC	Armament Research, Development and Engineering Center	MPTS	Mobile Plasma Treatment System
ASA(AL&T)	Assistant Secretary of the Army (Acquisition, Logistics and Technology)	OB	Open Burn
ASC	Army Sustainment Command	OCONUS	Outside Continental United States
BEDS	Bulk Energetic Demilitarization System	OD	Open Detonate
BGAD	Blue Grass Army Depot	OEESCM	Operational Environmental Executive Steering Committee for Munitions
BLUF	Bottom Line Up Front	OSHA	Occupational Safety & Health Administration
BRAC	Base Realignment and Closure	OUSD(AT&L)	Office of Under Secretary of Defense (Acquisition, Logistics and Technology)
CAAA	Crane Army Ammunition Activity	PAD	Propellant Activated Device
CAD	Cartridge Activated Device	PBA	Pine Bluff Arsenal
CBU	Cluster Bomb Unit	PEO	Program Executive Office
CEM	Combined Effects Munitions	PODS	Plasma Ordnance Demil System
CONUS	Continental United States	PGM	Product Group Manager
DAC	Defense Ammunition Center	PM	Product Manager
DIHME	Demilitarization by Induction Heating Meltout	R&D	Research and Development
DoD	Department of Defense	R3	Resource Recovery and Recycling
EDCA	Executive Director for Conventional Ammunition	RFI	Request for Information
EPA	Environmental Protection Agency	RFP	Request for Proposal
FMS	Foreign Military Sales	RRMC	Red River Munitions Center
FY	Fiscal Year	SIAD	Sierra Army Depot
HE	High Explosive	SMCA	Single Manager for Conventional Ammunition
HMX	High Melting Explosive	TBD	To Be Determined
HQ	Headquarters	TCG IX	Technology Coordination Group 9
HWAD	Hawthorne Army Depot	TEAD	Tooele Army Depot
IAAAP	Iowa Army Ammunition Plant	TOW	Tube Launched, Optically Tracked, Wire Guided
ICM	Improved Conventional Munitions	USA	United States of America
IM	Insensitive Munition		

Much of government is acronyms – here is some help.



Discussion Forum **Exploring Business Opportunities** **with the Recycling Industry**

Panel Participants

- LTC Brian Raftery – PM Demil
- Mr. Orest Hrycak – Project Engineer, OPM Demil
- Mr. Barry Schaffer – Demil Metals, Inc.

Please state your name and company affiliation with your questions to the panel. With that information we will be able to respond later, if necessary, with follow-up information.

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We are now open for comment and questions. Our panel consists of:

- Mr. Orest Hrycak who has a background in munitions engineering,
- Mr. Barry Schaffer who has experience in your industry with munitions scrap recycling and
- Myself, LTC Brian Raftery, PM Demil.

We would like to make this session completely informal to encourage your participation. **Jim Lawrence** will try to maintain control by recognizing the speaker and directing the discussion.